US Army Corps
of Engineers
San Francisco District

Coyote Creek at Rock Springs Road
Santa Clara County, California

Review of Existing Hydrology

25 January 2001

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1. **General**. This report presents findings and recommendations following a review of an existing hydrology study for possible use in a Section 205 flood control study for Coyote Creek at Rock Springs Road in the City of San Jose. The existing June 1977 hydrology study was prepared by the San Francisco District and is entitled *Hydrologic Engineering Office Report for Guadalupe River and Coyote Creek, Santa Clara County, California.* The 1977 tabulation of one-percent and Standard Project Flood peak flows estimated for 2010 conditions for various locations on both Coyote Creek and Guadalupe River are shown on Enclosure 1.

2. **Items for Further Investigation**. In reviewing the 1977 hydrology report for adequacy it was determined that several issues required further investigation before results from that study could be used in the Rock Springs Road study. These were:

(a) An additional 21 years of streamflow measurements at the USGS streamgaging station *Coyote Creek near Edenvale* are available for analysis;
(b) The Anderson Dam spillway was widened in 1990 and could affect downstream peak flows;
(c) The operational rule curves for Anderson and Coyote Dams have changed since the 1977 study; and
(d) Future hydrology in the 1977 study was developed for the year 2010, whereas, the Section 205 study requires future hydrology to be estimated for the year 2050.

3. **Additional Flow Records**. Since completion of the 1977 study an additional 21 years of streamgage records are available from the Coyote Creek near Edenvale gaging station. A tabulation of recorded peak flows at the gage site since construction of Anderson Dam in 1950 is presented as Enclosure 2. Because of the varying storage effects of Anderson and Coyote Dams, which are located upstream of the gage site, a statistical analysis of the peak flows was not considered appropriate. Consequently, it was decided to test the 1977 discharge vs. frequency curve by plotting the eight annual peak flows since 1951 that involved spilling from Anderson Dam by use of the Weibull plotting formula which is:

$$P = m/(N+1)$$

where:

m = the ordered sequence of flood values with the largest equal to 1; and
N = the number of records in the data set.

The eight peak flows and their associated plotting positions are presented in Table 1, below.

Table 1

Coyote Creek near Edenvale

Plotting Positions for Peak Annual Flows with Anderson Dam Spilling

Ranking	Water Year	Peak Flow (cfs)	Plotting Position (%)
1	1997	7,380	2.04
2	1983	6,460	4.08
3	1958	6,250	6.12
4	1998	4,970	8.16
5	1982	4,300	10.2
6	1969	3,580	12.2
7	1995	2,780	14.3
8	1974	905	16.3

As shown on Enclosure 3, the eight recorded peak flows that involved spilling from Anderson Dam reasonably fit the 1977 peak discharge vs. frequency curve indicating that that curve is still valid.

4. **Effects of Anderson Dam Spillway Modification**. The spillway of Anderson Dam was widened in 1990 to 218.5 feet, with the crest remaining at elevation 625 feet NGVD. The Anderson Dam spillway rating curves for pre- and post-modification and corresponding data, which were supplied by the Santa Clara Valley Water District (SCVWD), are shown on Enclosure 4.

In order to determine the effects of widening the spillway, multiples (0.25, 0.50, 1.0, and 1.25 times) of the one-percent flood inflow hydrograph presented on Plate 26 of the Corps' 1977 report were routed through the reservoir for both old and new spillway conditions. These four inflow hydrographs are shown on Enclosure 5. Inflow and outflow hydrographs for the routing of the one-percent flood through Anderson Dam with an initial storage of 81,000 acre-feet are shown on Enclosure 6.

As seen in Table 2, the effect of widening the Anderson Dam spillway results in increases to the spillway peak flow rates that range from approximately 2 to 15 percent for the four cases studied.

Table 2

Anderson Dam
Outflow Peak Flow Rates (cfs) for Old and New Spillway*

Multiples of 1% Flood	Original Spillway	Modified Spillway	Percent Increase	Remarks
0.50	4,770	5,500	15	10-percent flood (approx.)
0.75	9,780	10,600	8	
1.00	15,300	15,800	3	One-percent flood
1.25	20,900	21,200	2	

* Assumes a starting storage of 81,000 acre-feet in the Anderson Dam reservoir and 16,000 acre-feet in the Coyote Dam reservoir (1977 study conditions).

It should be noted that the 1977 report indicates a peak outflow of 14,600 cfs from Anderson Dam during the one-percent flood, whereas, Table 1 indicates a value of 15,300 cfs for this study. This apparent discrepancy may have resulted from the need to graphically determine the inflow ordinates from the plotted hydrograph in the 1977 report or from other causes; however, it should not affect the determination of percent changes caused by the widening of the spillway.

5. **Change in Operation of Anderson and Coyote Dams.** In the 1977 hydrology study, it was assumed that the storage in Anderson Dam reservoir would be 81,000 acre-feet (89% full) at the start of the one-percent flood event. Similarly, it was assumed that the initial storage in Coyote Dam reservoir would be 16,000 acre-feet (73% full).

According to SCVWD personnel, the rule curves for the operation of Anderson and Coyote Dams have been combined into one curve since the 1977 study. The combined storage rule curve data for the months of November through April are shown on Enclosure 7. It is also understood that the storage in Coyote Dam reservoir is now limited to 12,000 acre-feet, although operating procedures allow up to 30 days to reach that level following a major inflow. SCVWD personnel indicated that more water would be allowed to be stored in Anderson Dam reservoir to offset the reduction in Coyote Dam reservoir as long as the rule curve and other safety considerations are not violated.

For this analysis, it is assumed that the changes in the storage allocations for the two reservoirs will approximately offset each other and that the total available storage at the beginning of the one-percent storm will be the same as in the 1977 study. With no net change, the initial storage in Anderson Dam and Coyote Dam reservoirs for this analysis was assumed to be 81,000 and 16,000 acre-feet, respectively.

As a sensitivity check, the one-percent inflow hydrograph was routed through Anderson Dam reservoir with four different starting storage levels. The results of the sensitivity check are presented in Table 3, below.

Table 3

Anderson Dam
Initial Reservoir Storage vs. Peak Spillway Discharge*

Initial Storage in Anderson Dam (acre-feet)	Peak Spillway Outflow (cfs)
81,000 (same as in 1977 study)	15,800
84,000	16,700
85,000	17,000
89,000 (spillway crest)	17,800

*Assumes 1990 modified Anderson Dam spillway with the 1977 assumption of 16,000 acre-feet of initial storage in Coyote Dam.

6. **Effects of Urbanization.** The peak flows presented in the Corps' 1977 study were determined for existing (1980) and future (2010) watershed conditions. For this study,

existing and future watershed conditions are those expected to occur in the years 2000 and 2050, respectively.

In order to estimate watershed conditions for future urbanization, the Land Use Map for the City of San Jose 2020 General Plan, as amended through 1999, was used as a guide. Similarly, the Land Use Map for the Santa Clara County 2010 General Plan, as adopted on 20 December 1994, was also used.

It is believed that the increase in peak flows caused by upstream urbanization through the year 2050 would be insignificant based on the following considerations:

(a) Eighty-two percent of the watershed upstream of the project site is located above Anderson Dam where additional runoff from future urbanization is considered to be insignificant;

(b) The larger peak flows at the project site result primarily from flow over the Anderson Dam spillway. Because of timing effects, increased runoff from drainage areas located between the project site and Anderson Dam would add little to the spillway peak flows reaching the project site.

(c) It is expected that local planning constraints will require that there be no significant increase in downstream peak flows on Coyote Creek caused by urbanization in the major drainage areas between the project site and Anderson Dam, such as in the Fisher Creek and Upper Silver Creek watersheds.

7. **Peak Discharge vs. Frequency Curve for Project Site**. As discussed earlier, it is believed that the changes in the operation of Anderson and Coyote Dams and upstream urbanization will not significantly alter the 1977 peak discharge vs. frequency relationship for Coyote Creek near Edenvale which is applicable to the proposed study site. However, estimates shown in Table 1, above, indicate that the modified spillway could increase the 10-percent and one-percent chance spillway peak discharges by about 15 and 3 percent, respectively. Therefore, as a result of the modification to Anderson Dam spillway it is recommended that the peak discharge vs. frequency relationship shown Table 4, below, be considered for use in the Rock Springs Road study. A plot of the recommended peak discharge vs. frequency relationship is presented on Enclosure 8.

Table 4

Peak Discharge vs. Frequency Relationships*
for
Coyote Creek near Edenvale (D.A. 228 sq. mi.)

Percent Chance of Occurrence	1977 Corps Study with Original Spillway	Present Corps Study with Modified Spillway**
50	180	180
20	900	900
10	4,400	5,100
4	8,200	9,000
2	11,200	12,000
1	15,000	15,400
0.4	20,000	17,000***
0.2	24,500	17,000***

* Peak flows in cfs
** Reflects both existing and future basin conditions
*** Limited by upstream losses from system

The one-percent peak flow of 15,400 cfs was determined by increasing the 1977 peak spillway discharge of 14,600 cfs by three percent for spillway widening and then adding a local inflow contribution below Anderson Dam of 400 cfs as was done in the 1977 study (see Enclosure 1).

The 10- and 2-percent peak flows for the this review were obtained by increasing the 1977 study flows by 15 and 7 percent for spillway widening, respectively, based on the values presented in Table 1.

Citing the reference on page 32 of the Corps' 1977 hydrology report, it is estimated that the flow rate on Coyote Creek in the vicinity Rock Springs Road probably cannot exceed 17,000 cfs. The stated reason for this is the loss of flow from the basin in the Canoas Creek area further upstream. Since it is not likely that the Coyote Creek channel in the Canoas overflow area would be improved to that extent, it is recommended that 17,000 cfs be considered as the upper limit of the peak discharge vs. frequency curve for the Rock Springs Road work site.

TABLE 11

STANDARD PROJECT FLOOD AND ONE PERCENT CHANCE FLOOD
PEAK DISCHARGE AND STORM DATA
GUADALUPE RIVER AND COYOTE CREEK BASINS, SANTA CLARA COUNTY, CALIFORNIA

LOCATION	DRAINAGE AREA SQUARE MILES	NORMAL ANNUAL PRECIPITATION INCHES	1% CHANCE FLOOD					SPF		
				RUNOFF INCHES		PEAK DISCHARGE-CFS				
GUALALUPE RIVER BASIN			RAINFALL INCHES	UNIMPAIRED	FUTURE CONDITIONS	UNIMPAIRED	FUTURE CONDITIONS	RAINFALL INCHES	RUNOFF INCHES	PEAK DISCHARGE CFS
Alamitos Creek near New Almaden	38	26	12.3	6.2	5.0	11,900	8,700	14.1	9.3	12,200
Gualalupe Creek at Alamitos Creek	14	29	13.7	8.0	6.1	5,100	3,500	15.8	11.1	5,700
Guadalupe River at Alamitos Perculation Ponds	53	27	12.7	6.7	5.3	16,900	11,400	14.6	9.8	17,800
Gualalupe River above Los Gatos Creek	92	23	10.7	5.3	4.5	18,100	14,600	12.5	8.3	19,800
Los Gatos Creek below Lexington Dam	37	38	17.8	10.7	5.0	16,000	7,500	20.5	14.1	14,800
Los Gatos Creek at Guadalupe River	52	33	15.4	9.0	4.9	15,600	7,800	17.8	11.8	16,100
Guadalupe River at San Jose	144	27	12.4	6.6	4.7	33,700	17,000	14.4	9.6	34,900
COYOTE CREEK BASIN										
Coyote Creek at Coyote Dam (Inflow)	120	22.5	10.4	5.2	5.2	20,000	20,000	11.7	7.2	23,000
Coyote Creek near Madrone	196	21.0	9.6	4.5	3.0	26,000	14,600	10.7	6.3	23,200
Coyote Creek near Edenvale	228	20.3	9.2	4.2	2.7	26,900	15,000	10.2	5.8	24,500
Coyote Creek below Silver Creek	284	19.6	8.7	3.9	2.4	24,600	14,200	9.6	5.4	23,800
Coyote Creek below Penitentia Creek	308	19.6	8.6	3.8	2.3	25,200	14,200	9.6	5.3	24,200

ENCL 1

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áááááááááááááááááááááá   FINAL RESULTS   áááááááááááááááááááááá

   )TTING POSITIONS- 11171500 EDENVALE GAUGING STATION DA=229 SQ
  ¸ëëëëëëëëëëëëëëëëëëëëëëëëëîëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëë£
¤      EVENTS ANALYZED      °          ORDERED EVENTS           ¤
¤                   FLOW    °       WATER      FLOW   WEIBULL   ¤
¤ MON DAY  YEAR     CFS     °  RANK  YEAR      CFS    PLOT POS  ¤
úáááááááááááááááááááááááááááéááááááááááááááááááááááááááááááááááÑ
¤   0   0  1951       400.  °     1  1997       7380.     2.04  ¤
¤   0   0  1952       768.  °     2  1983       6460.     4.08  ¤
¤   0   0  1953       102.  °     3  1958       6250.     6.12  ¤
¤   0   0  1954        24.  °     4  1998       4970.     8.16  ¤
¤   0   0  1955        34.  °     5  1982       4300.    10.20  ¤
¤   0   0  1956      1610.  °     6  1969       3580.    12.24  ¤
¤   0   0  1957        47.  °     7  1995       2780.    14.29  ¤
¤   0   0  1958      6250.  °     8  1986       1860.    16.33  ¤
¤   0   0  1959      1410.  °     9  1996       1660.    18.37  ¤
¤   0   0  1960        71.  °    10  1956       1610.    20.41  ¤
¤   0   0  1961        16.  °    11  1959       1410.    22.45  ¤
¤   0   0  1962       159.  °    12  1974        901.    24.49  ¤
¤   0   0  1963         3.  °    13  1980        858.    26.53  ¤
¤   0   0  1964        60.  °    14  1952        768.    28.57  ¤
¤   0   0  1965        44.  °    15  1978        674.    30.61  ¤
¤   0   0  1966        17.  °    16  1967        454.    32.65  ¤
¤   0   0  1967       454.  °    17  1973        441.    34.69  ¤
¤   0   0  1968        46.  °    18  1993        429.    36.73  ¤
¤   0   0  1969      3580.  °    19  1987        421.    38.78  ¤
    0   0  1970       272.  °    20  1951        400.    40.82  ¤
    0   0  1971        42.  °    21  1981        395.    42.86  ¤
    0   0  1972        62.  °    22  1979        323.    44.90  ¤
¤   0   0  1973       441.  °    23  1984        299.    46.94  ¤
¤   0   0  1974       901.  °    24  1970        272.    48.98  ¤
¤   0   0  1975       134.  °    25  1976        269.    51.02  ¤
¤   0   0  1976       269.  °    26  1962        159.    53.06  ¤
¤   0   0  1977        14.  °    27  1992        139.    55.10  ¤
¤   0   0  1978       674.  °    28  1975        134.    57.14  ¤
¤   0   0  1979       323.  °    29  1953        102.    59.18  ¤
¤   0   0  1980       858.  °    30  1994         80.    61.22  ¤
¤   0   0  1981       395.  °    31  1960         71.    63.27  ¤
¤   0   0  1982      4300.  °    32  1972         62.    65.31  ¤
¤   0   0  1983      6460.  °    33  1991         61.    67.35  ¤
¤   0   0  1984       299.  °    34  1964         60.    69.39  ¤
¤   0   0  1985        27.  °    35  1990         58.    71.43  ¤
¤   0   0  1986      1860.  °    36  1989         53.    73.47  ¤
¤   0   0  1987       421.  °    37  1988         51.    75.51  ¤
¤   0   0  1988        51.  °    38  1957         47.    77.55  ¤
¤   0   0  1989        53.  °    39  1968         46.    79.59  ¤
¤   0   0  1990        58.  °    40  1965         44.    81.63  ¤
¤   0   0  1991        61.  °    41  1971         42.    83.67  ¤
¤   0   0  1992       139.  °    42  1955         34.    85.71  ¤
¤   0   0  1993       429.  °    43  1985         27.    87.76  ¤
¤   0   0  1994        80.  °    44  1954         24.    89.80  ¤
    0   0  1995      2780.  °    45  1966         17.    91.84  ¤
    0   0  1996      1660.  °    46  1961         16.    93.88  ¤
    0   0  1997      7380.  °    47  1977         14.    95.92  ¤
¤   0   0  1998      4970.  °    48  1963          3.    97.96  ¤
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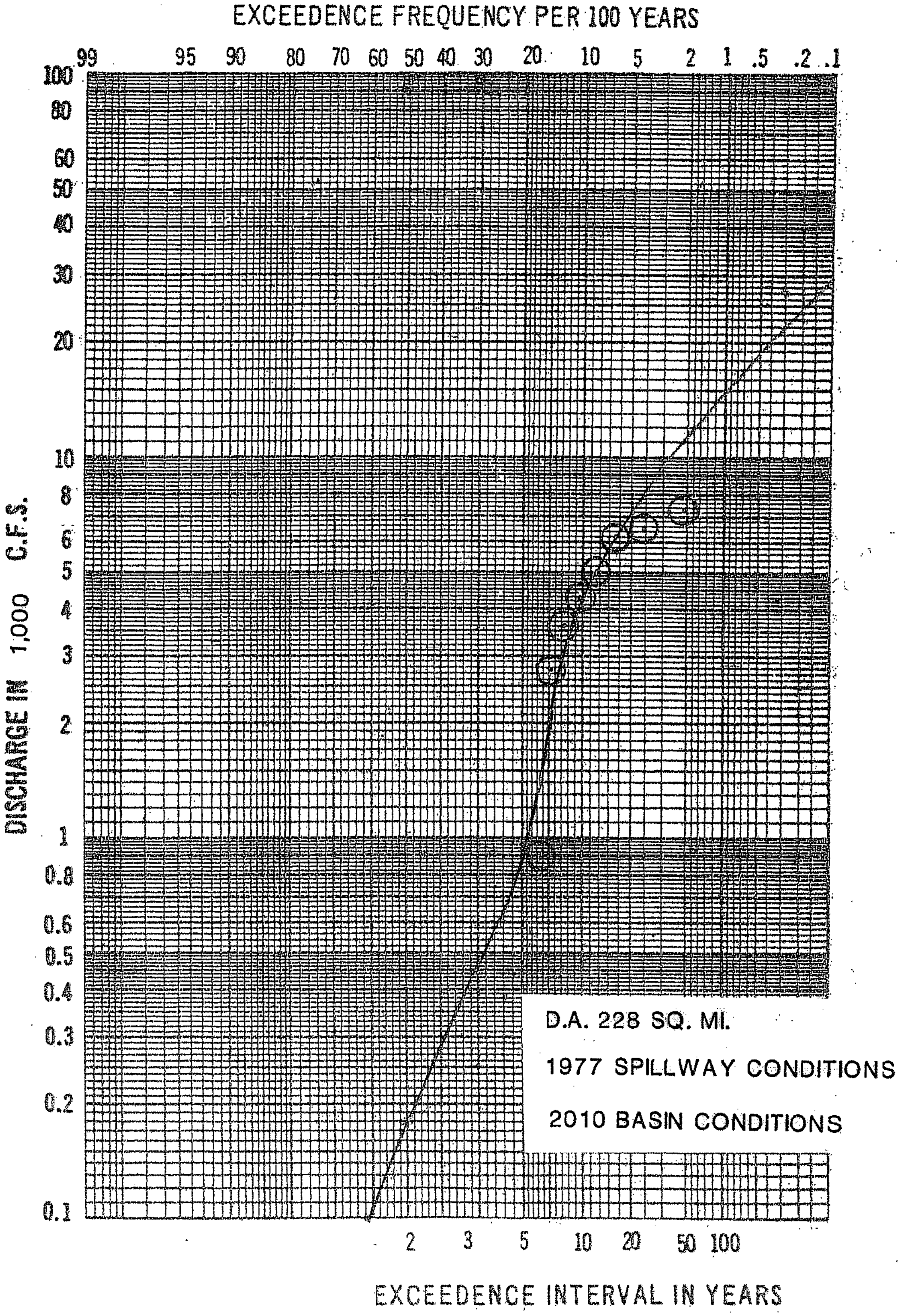
ENCL 2



D.A. 228 SQ. MI.

1977 SPILLWAY CONDITIONS

2010 BASIN CONDITIONS

⊙ RECORDED PEAK FLOWS WITH ANDERSON DAM SPILLING

PEAK DISCHARGE VS.
FREQUENCY CURVE

COYOTE CREEK NEAR EDENVALE

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
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TO ACCOMPANY REPORT
CHECKED:
DATED

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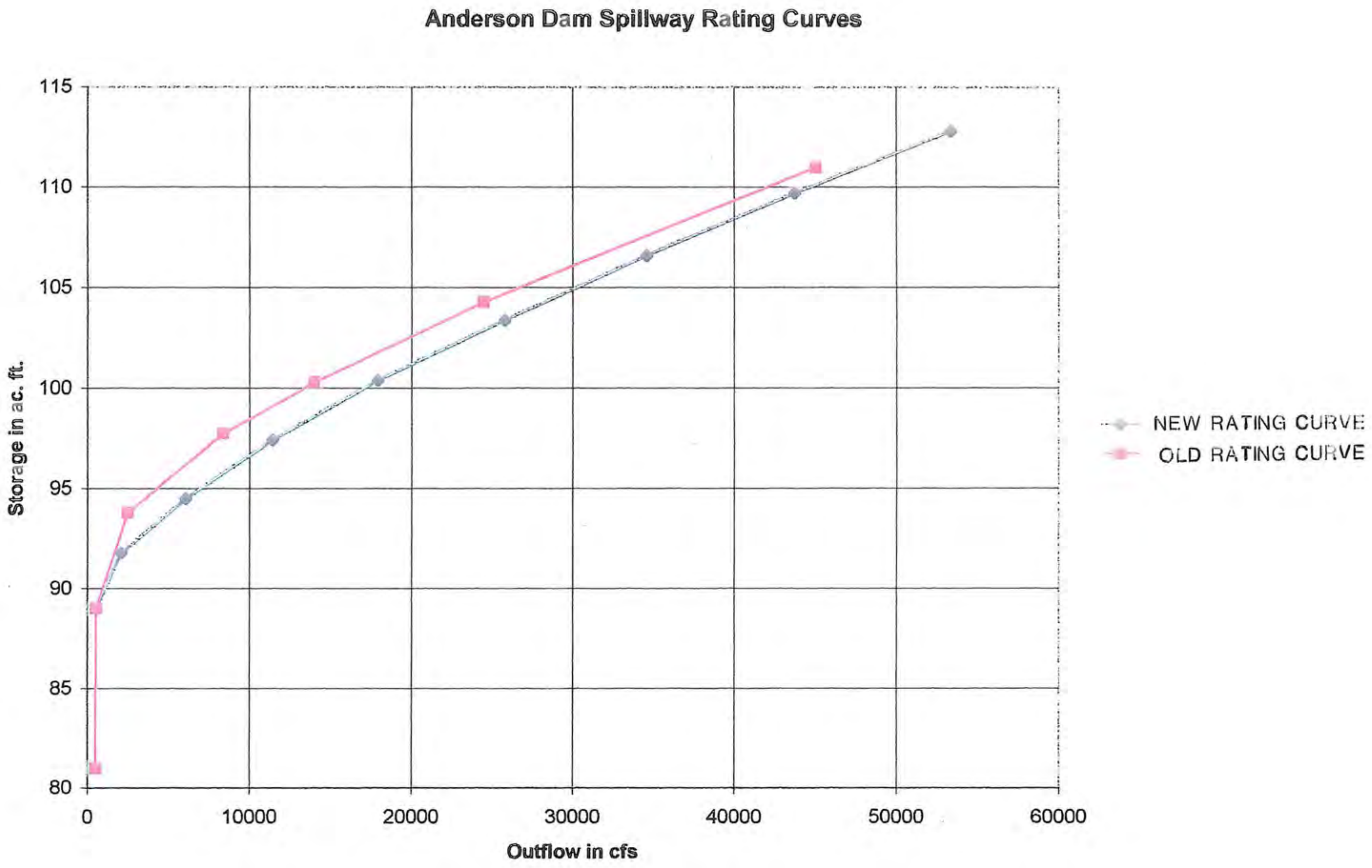
PLATE

ENCL 3



Anderson Dam Spillway Rating Curves

ENCL 4

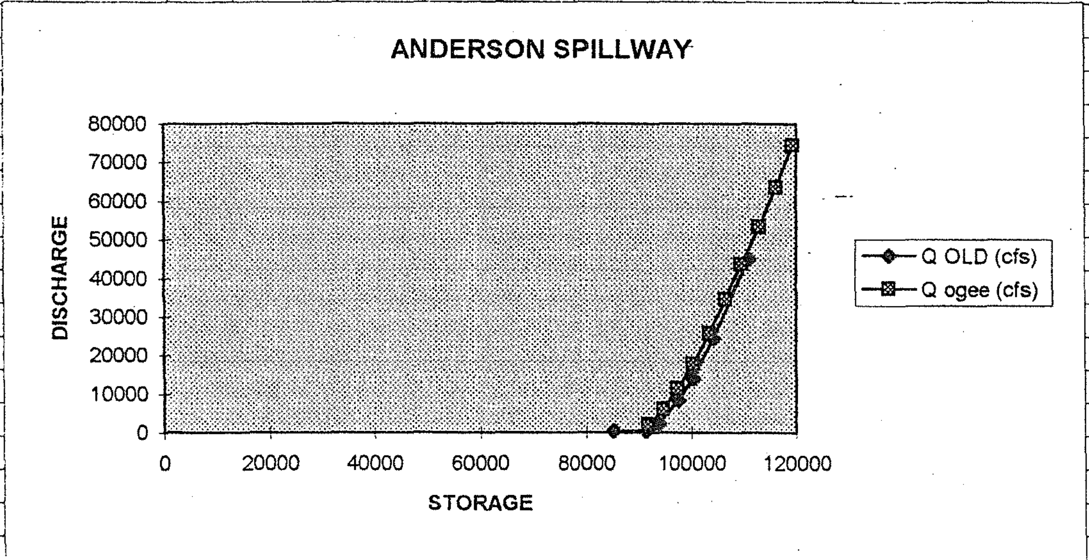
RAGE DISCHARGE RELATIONSHIP FOR ANDERSON DAM
Y W. CHANG (MAY 96)

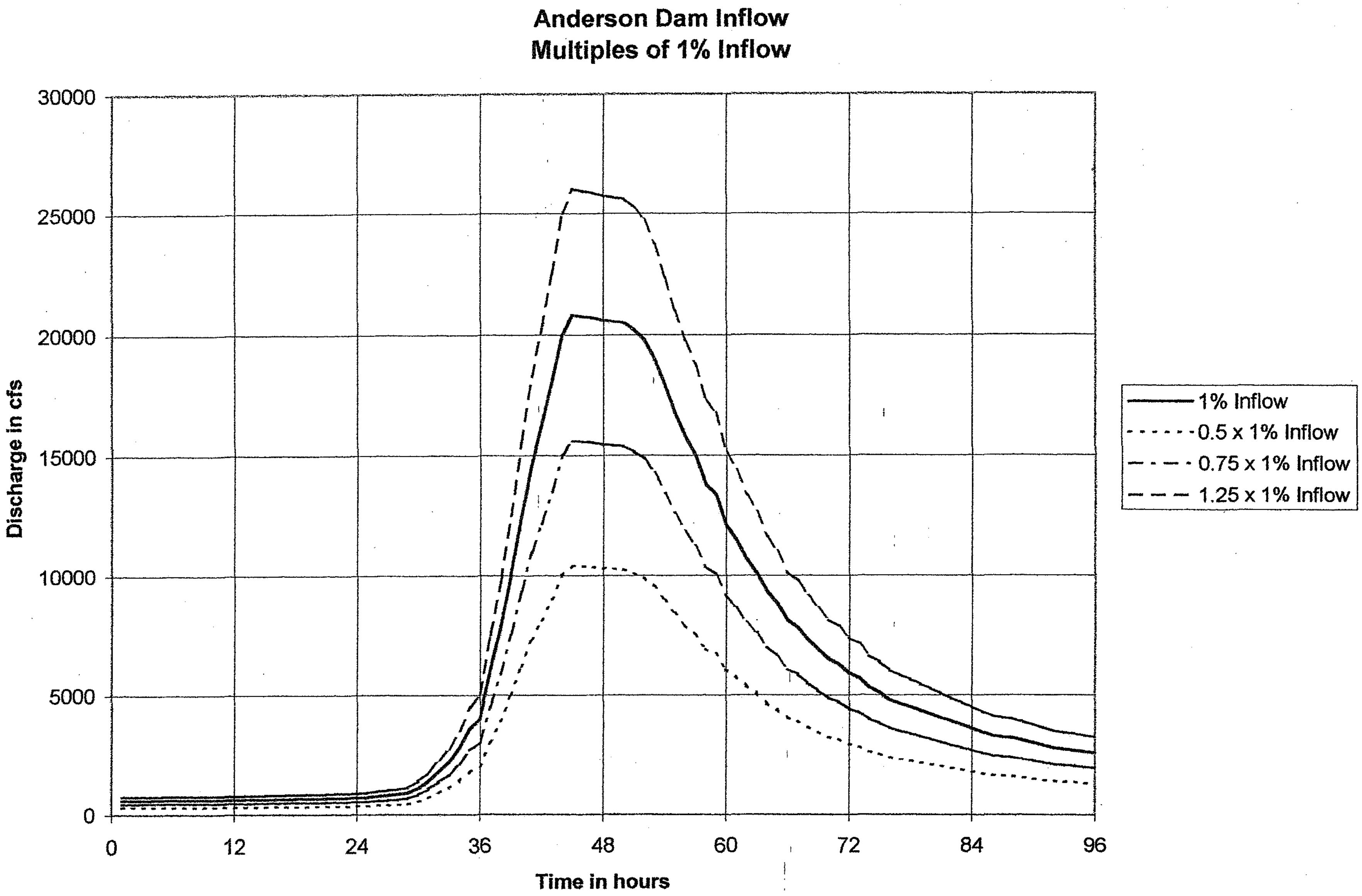
L (ft)	P (ft)	ha (ft)	Ho (ft)	P/Ho	Co 1)	Ci 2)	Co (corr) 3)
[illegible]	7.02	1.64	14	0.50	3.8	3.86	3.86

ELEV (ft)	He (ft)	He/Ho	4) C/Co (corr)	C	hd+d/He	3) Cs/C	C (corr)	6) STORAGE	5) Q ogee (cfs)
624.95	0	0						89012	
627	2.05	0.15	0.84	3.24	7.28	1	3.24	91801	2079
629	4.05	0.29	0.88	3.40	4.18	1	3.40	94529	6049
631	6.05	0.43	0.91	3.51	3.13	1	3.51	97401	11421
633	8.05	0.57	0.93	3.59	2.60	1	3.59	100416	17915
635	10.05	0.72	0.96	3.71	2.28	1	3.71	103432	25796
637	12.05	0.86	0.98	3.78	2.07	1	3.78	106552	34574
639	14.05	1.00	1	3.80	1.92	1	3.80	109672	43727
641	16.05	1.15	1.02	3.80	1.80	1	3.80	112849	53388
643	18.05	1.29	1.04	3.80	1.71	1	3.80	116080	63672
645	20.05	1.43	1.05	3.80	1.64	1	3.80	119312	74543

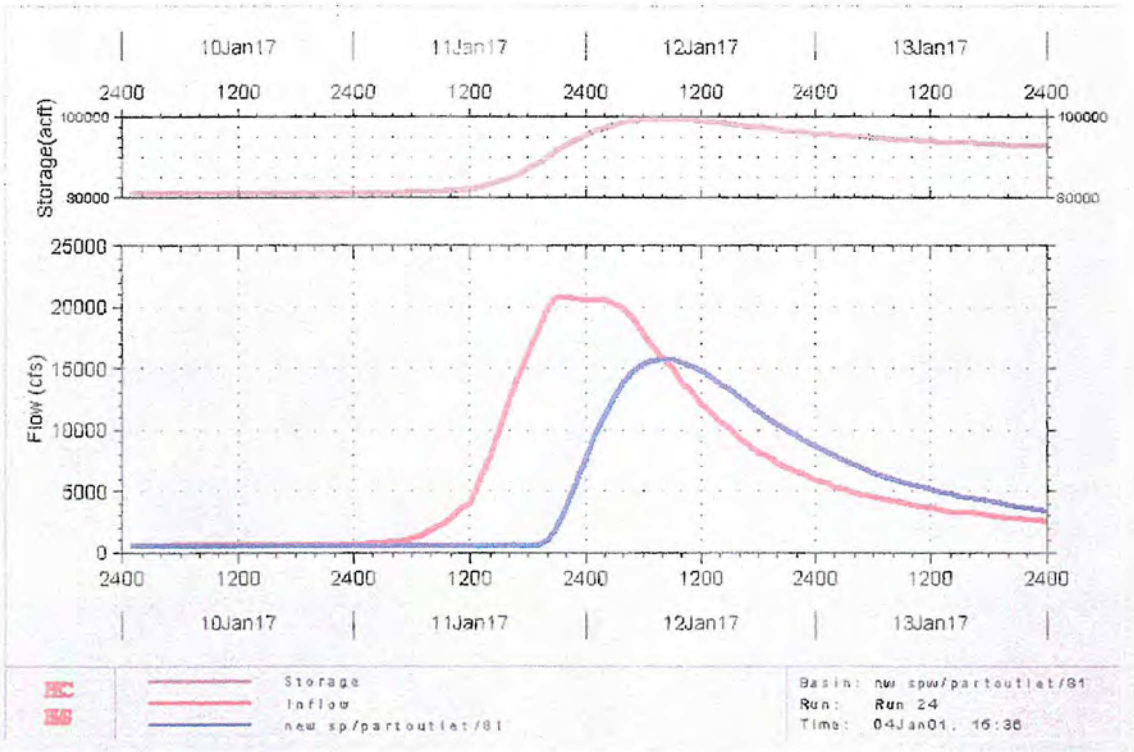
1) EFFECT OF DEPTH OF APPROACH ON COEFFICIENT, FROM FIG. 9.23 "DESIGN OF SMALL DAM"
2) EFFECT OF INCLINED UPSTREAM SLOPE ON COEFFICIENT. FROM FIG.9.25 "DESIGN OF SMALL DAM"
3) EFFECT OF D/S APRON INTERFERENCE AND D/S SUBMERGENCE ON COEFFICIENT, FROM FIG. 9.27 "DESIGN OF SMALL DAM"
4) EFFECT OF HEADS DIFFERING FROM DESIGN HEAD ON COEFFICIENT, FROM FIG. 9.24 "DESIGN OF SMALL DAM"
5) Q ogee =CL(He^3/2)
6) DATA FROM SCVWD RESERVOIR STORAGE AND SURFACE AREA RATING CURVES, MAR. 91
C<3.8 (IF C>3.8 ADJUST TO 3.8)

[illegible]E	Q OLD (cfs)
[illegible]20	543
91279	551
93792	2500
97654	8370
100292	14000
104348	24500
111000	45060




Anderson Dam Inflow
Multiples of 1% Inflow
Discharge in cfs
30000
25000
20000
15000
10000
5000
0
0
12
24
36
48
60
72
84
96
Time in hours
1% Inflow
0.5 x 1% Inflow
0.75 x 1% Inflow
1.25 x 1% Inflow

ENCL 5



ONE-PERCENT FLOOD INFLOW AND OUTFLOW HYDROGRAPHS FOR ANDERSON DAM

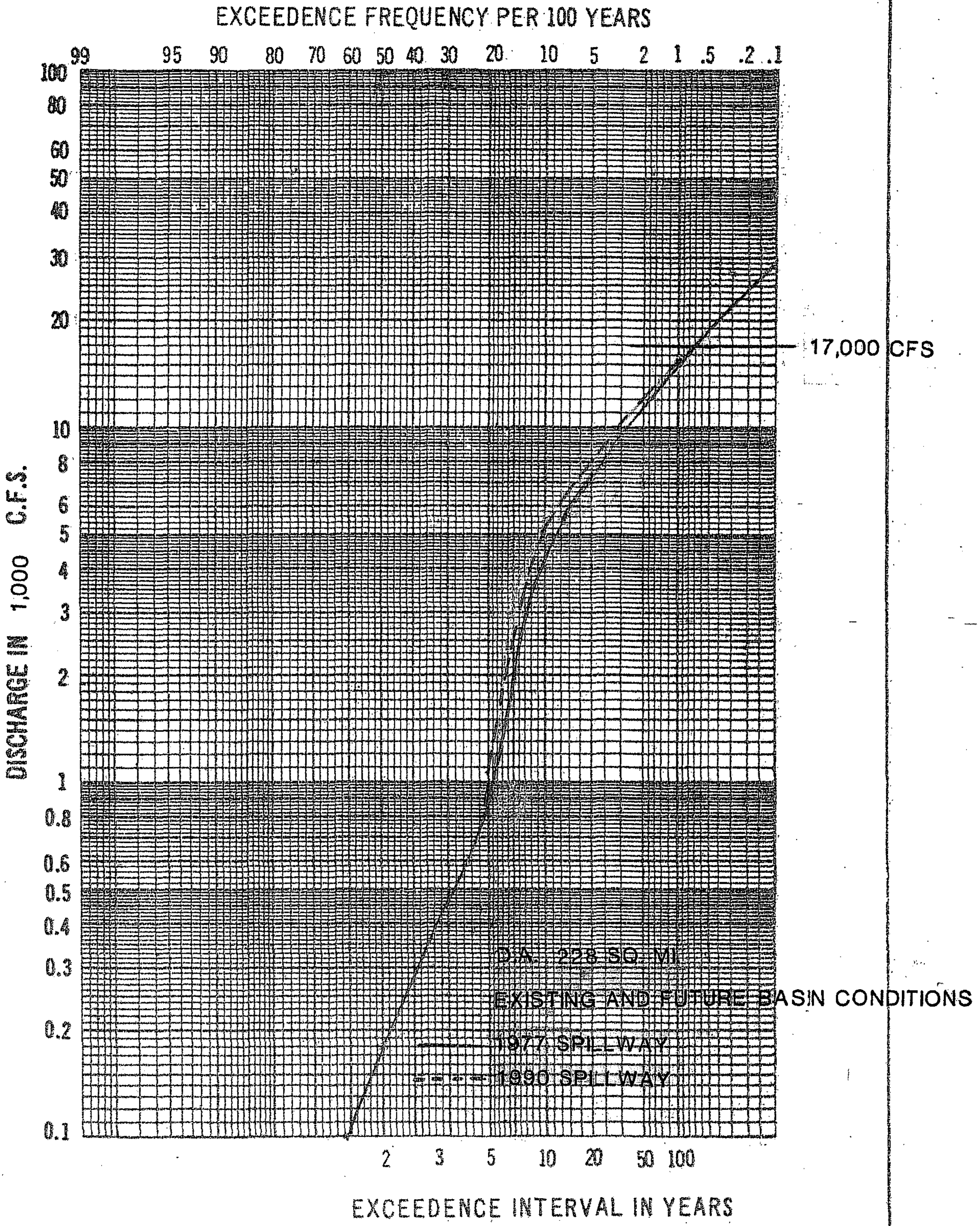
Notes: One Percent Inflow with Modified Anderson Dam Spillway
Starting Storage: 81,000 Acre-Feet

ENCL 6

ANDERSON COYOTE COMBINED STORAGE RULECURVE

DAY		nov	dec	jan	feb	mar	apr
1		81,226	74,000	78,387	86,533	95,172	108,226
2		80,710	74,000	78,645	86,800	95,517	108,710
3		80,194	74,000	78,903	87,067	95,862	109,194
4		79,677	74,000	79,161	87,333	96,207	109,677
5		79,161	74,000	79,419	87,600	96,552	110,161
6		78,645	74,000	79,677	87,867	96,897	110,645
7		78,129	74,000	79,935	88,133	97,241	111,129
8		77,613	74,000	80,194	88,400	97,586	111,613
9		77,097	74,000	80,452	88,667	97,931	111,998
10		76,581	74,000	80,710	88,933	98,276	111,998
11		76,065	74,000	80,968	89,200	98,621	111,998
12		75,548	74,000	81,226	89,467	98,966	111,998
13		75,032	74,000	81,484	89,733	99,310	111,998
14		74,516	74,000	81,742	90,000	99,655	111,998
15		74,000	74,000	82,000	90,345	100,000	111,998
16		74,000	74,258	82,267	90,690	100,484	111,998
17		74,000	74,516	82,533	91,034	100,968	111,998
18		74,000	74,774	82,800	91,379	101,452	111,998
19		74,000	75,032	83,067	91,724	101,935	111,998
20		74,000	75,290	83,333	92,069	102,419	111,998
21		74,000	75,548	83,600	92,414	102,903	111,998
22		74,000	75,806	83,867	92,759	103,387	111,998
23		74,000	76,065	84,133	93,103	103,871	111,998
24		74,000	76,323	84,400	93,448	104,355	111,998
25		74,000	76,581	84,667	93,793	104,839	111,998
26		74,000	76,839	84,933	94,138	105,323	111,998
27		74,000	77,097	85,200	94,483	105,806	111,998
28		74,000	77,355	85,467	94,828	106,290	111,998
29		74,000	77,613	85,733		106,774	111,998
30		74,000	77,871	86,000		107,258	111,998
31			78,129	86,267		107,742	

ENCL 7



NOTE: ESTIMATED LIMIT OF 17,000 CFS BASED ON UPSTREAM CHANNEL CAPACITY

PEAK DISCHARGE VS.
FREQUENCY CURVE

COYOTE CREEK NEAR EDENVALE

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
DRAWN:
FILE NO.
TRACED: TO ACCOMPANY REPORT
CHECKED: DATED

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1 APR 72

PLATE

ENCL 8